IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: Laslaz et al.	Group Art Unit: 1742 Examiner: J.A. Morillo
Serial No.: 10/518,597	
Filed: December 21, 2004	
For: PART CAST MADE FROM ALUMINUM ALLOY WITH HIGH HOT STRENGTH	

DECLARATION UNDER 37 CFR 1.132

Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Michel Garat, do hereby declare as follows:

1. I graduated in 1973 as an Engineer of the Ecole de Physique et de Chimie Industrielles de la Ville de Paris. I also obtained a DEA in Polymers in 1973.
2. I joined Pechiney CRV (known as the Voreppe R&D center) in 1974 and spent my whole career within this Group and stayed with its subsidiary Aluminium Pechiney when it was purchased by Alcan, which was later itself purchased by RioTinto. I have always worked in the field of Foundry Alloys, either in research and/or in development. I am at present a Project Manager, R&D Foundry Alloys in Rio Tinto Alcan's Primary Metal group and am located in Voreppe. In total, I have worked approximately in the aluminum industry more than 35 years specializing in aluminium foundry metallurgy, automobile applications and casting processes. I am a named inventor of the above-identified patent application ("the present application").

I am familiar with SU 348633 ("SU '633") as well as US Patent No 2,821,495 to Dulin ("Dulin"), both of which I understand have been cited in connection with the present application. I have also generally reviewed as a scientist an office action dated November 21, 2008 issued in connection with the present application. I am also familiar with a declaration dated April 27, 2007 ["the prior declaration"].

3. I confirm that as one of skill in the art, it is my opinion that the unexpected results detailed in the tested examples described in the prior declaration to be relevant across the entire scope of the claimed alloying range; that is, for Si 5-11, Fe at most up to 0.3, Mg 0.25-0.5, Cu 0.3-1.5, Ti 0.05-0.25, Zr 0.05-0.25, Mn <0.4, Zn <0.3, Ni <0.4, other <0.10 each, <0.30 total, remainder aluminum. I have this opinion because the Zirconium addition of from 0.05-0.25% improves the creep resistance by forming very fine AlZr(Ti)Si phases (of the order of 0.3 μm) during the solution treatment generally at between 500 and 540°C. It is my experience that only the Si in solid solution in the aluminum dendrites (about 1.5% independently from the total amount of 5 to 11%) can combine with Zr and Al to form these phases and the silicon in excess (5 to 11% minus 1.5%) is in the form of comparatively coarse eutectic crystals (about 10 μm) which do not interact with Zr. The other elements Fe, Cu, Mg, Zn, Ni, Mn do not play any part in the AlZr(Ti)Si phases and therefore, the recited ranges would be expected to also display the unexpected results across those ranges recited in claim 1. Ti partly combines with Al,Zr and Si, and is favorable to creep resistance and the range of 0.05-0.25% Ti is what would be expected to work best in this case.

4. I understand that the US Patent & Trademark Office ["PTO"] has taken the position that ranges in the present claims allegedly (i) overlap, (ii) touch a boundary, or (iii) are close approximations with ranges the disclosure of SU '633 and based on this allegations, has ruled that the present claims are obvious. First of all, as one of skill in the art, I respectfully disagree that the claimed ranges overlap, touch a boundary or are close approximations with the disclosure of SU

'633 or Dulin with regard to several of the elements. Indeed, the way the claims in the present application read, the language reads "consisting of" which I understand means that nothing else is included in the alloy other than what is stated in the claims.

5. I will address SU '633 first. With respect to the magnesium level : SU'633 teaches Mg 0.5 – 0.9%, whereas the present application claims Mg 0.25 – 0.50%. Thus, only the single data point 0.5% is in common. But the present application requires Mg at or BELOW 0.5%, while SU '633 teaches Mg at of ABOVE 0.5%. Thus, I do not agree it would be obvious to one of skill in the art to use the SU '633 endpoint and go the opposite direction in terms of Mg content. First of all, the solid solubility limit of Mg in AlSi 5 to 10 Cu 0.3 – 1.5% base alloys is of the order of 0.6% (0.55 – 0.65% according to the various phase diagrams published). Magnesium in excess of 0.6% remains out of solution after the solutionizing step of the heat treatment in the form of coarse intermetallic compounds (Q-AlSiCuMg), which drastically decrease the ductility and only moderately improve the yield or ultimate tensile strength of the alloy. An alloy of the present application is intended for turbo-diesel cylinder heads which undergo severe thermal fatigue in the intervalve bridge areas. As ductility has been identified as a key parameter to avoid or retard the initiation and propagation of thermal fatigue cracks, the present application developed a domain of Mg levels which can be entirely solutionized by an adequate heat treatment, such as that cited in example 1 of the present application[1] . AlSi 10 to 18 Cu 1 to 1.5 Mg piston alloys often contain Mg 0.8 to 1.2% because ductility is not an issue in piston alloys and only the maximization of the yield strength, hardness and wear resistance are sought. Even in such alloys, the fact that the hardness and UTS only very slightly increase beyond Mg 0.6 has been described by R.F.Smart in "Metallurgical aspects of Al-Si eutectic piston alloys", a copy of which is attached hereto. So for these

[1] Note that there is an obvious error on translation : the correct time indicated in the PCT application is 10 hrs at 540°C, not 1 hr as printed in the US application, preceded by 4 hrs at 500°C

reasons, as one of skill in the art, I do not agree that the SU '633 would have motivated one of skill in the art to utilize the claimed Mg levels.

6. With respect to vanadium, SU'633 requires a specific addition of V 0.1- 0.3%. Therefore, if V is not added, in the claimed alloy only impurity levels of V could ever be present, which in primary alloys is < 0.03% each. Actually, in the alloys cast for examples A to H, the vanadium contents were of the order of 0.008%, which results from the presence of V as an impurity in alumina. So even though the claims state that other elements can be <0.1 each and <0.3 total, I would understand this language that V would necessarily be at impurity level which is < 003%. Since SU '633 consciously adds V to their alloy, there is simply no overlap with the present claims. Indeed, V is an expensive metal and the present application targets cylinder heads for very large volume production cars. Furthermore, an alloy of the present application can be substituted to the existing A356 or A356+Cu0.5% without any notable change in the foundry process. Consciously adding V would not be an option to one of skill in the art.
   To support my opinion, I refer to the « Aluminum Association » norm attached hereto. An alloy according to the invention has an AlSi7%Mg basis and a level of purity similar to that of the A356 / 357 group. Vanadium not being specifically mentioned in the Aluminum Association norm falls under the OTHERS / Each specification, which is either <0.05% or <0.03% for the A356/357 type. We intend to opt for the latter : each <0.03 %. I also refer to a recent analysis of all the impurities in a series of AlSi7Mg0.3 alloys produced in the Alcan plant of Dunkerque in France, which is the dedicated plant to produce alloys corresponding to the present application with a similar level of purity. (Excel table "Spectro.Analysis AD" attached). As shown in the Excel spreadsheet, it clearly appears that the vanadium content is only of the order of 0.006 %.

7. There is even a further reason why one of skill in the art would not seek to consciously add V to a composition of the present application. In a recent R&D program, we determined the solubility of V in the liquid melt as a function of the

temperature : it is summarized as follows :0.30% : > 750°C (not precisely determined, extrapolation of the curve suggests about 760°C), 0.27%: 750°C, 0.17% 720°C, 0.13% 690°C

8. Many cylinder head foundries hold the melt at 710 or 720°C (always with a +/- 10°C fluctuation inherent to industrial conditions) in the case of gravity permanent mold casting. In the case of Low Pressure PM casting, the average holding temperature may be as low as 690°C. For this reason, we decided not to add any Vanadium. Note that a level of 0.2 (the median value of SU'633) compels the foundry to work above 725°C, which implies setting the regulator at 735°C instead of 710 or 720°C with A356. This would lengthen the solidification time and thus reduce the production rate, and hence might affect the shrinkage behavior and would accelerate the wear of the die coating agent.

9. With respect to Misch Metal, SU'633 teaches the conscious addition of 0.1 – 0.2 of Misch metal (mixture of rare earth elements). In the past, we had investigated the effect of such additions in an AlSi7Mg alloy and did not observe the gains sometimes described in the literature. To the opposite, we observed a strong loss of ductility (by about a half). For this reason, we never contemplated to add rare earth elements to the claimed cylinder head alloy. Instead, as I understand the claims as one of skill in the art, Misch metal is not consciously added and as such, would be present only in impurity levels, which is namely < 0.03% as it can also be seen on the previously cited Excel table.

10. I will now turn to Dulin. With respect to Dulin and present claim 13, Dulin describes an alloy intended for a structural part which moreover is assembled (from two or more initial components) by brazing. In the industry, structural parts are either suspension parts (such as cross members, wishbones, knuckles,...) or body elements (such as A,B or C pillars, shock towers, structural nodes,...). These applications are not exposed to elevated temperatures and the main requirements are a high room temperature yield strength (for the static design) and

fatigue strength (dynamic design) and a very high elongation (energy absorption, crash behavior). Elevated temperature properties are immaterial.

11. An alloy of the present application, on the other hand, is intended for turbo diesel cylinder heads (which are never assembled from two or more components), in which the main requirements are a high yield strength and even more a very high creep strength in the 250°C – 300°C domain combined with a sufficient ductility in the domain between room temperature and 300°C to contribute to avoid thermal fatigue cracking. Crash behavior and energy absorption are generally immaterial. Thus, as one of skill in the art, it is my opinion that there would have been no motivation to cast Dulin's Al-Si alloy into a cylinder head or crankcase for at least this reason.

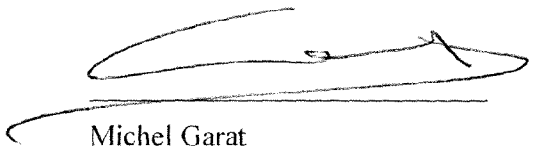
12. As to the alloy composition itself, as one of skill in the art, I am of the opinion that Dulin's disclosure does not suggest using an alloy having Si 5-11, Fe at most up to 0,3, Mg 0.25-0.5, Cu 0.3-1.5, Ti 0.05-0.25, Zr 0.05-0.25, Mn <0.4, Zn <0.3, Ni <0.4, other <0.10 each, <0.30 total, remainder aluminum. This is because our addition of Zirconium of 0.05 to 0.25%, and preferably (claim 8) 0.12 to 0.18% is, for example, entirely motivated by its strong positive effect on 300°C creep strength and has been carefully optimized. Levels of 0.30% Zr and above are excessive and have been shown to cause the presence of coarse AlZrSi platelets which make the alloy brittle. Dulin mentions Zr as an option among numerous other elements (Ti, Zr, Mn, Ni, Cr, B, Be) with a 0.01 – 1.0% content which is absolutely unrealistic : at 0.01%, Zr would have no beneficial effect on creep. At 1.0%, Zr (which is four times more than the upper limit in the alloy of the present application) would make the alloy completely brittle, and furthermore the holding temperature of the melt would have to be above 875°C which is not industrially practical : As explained *supra*, the optimal casting temperature of cylinder heads is of the order of 700 – 720°C. In the present application, the level of Copper of 0.3 – 1.5% and preferably 0.4 – 0.7% (claim 4) has also been carefully chosen to improve the elevated temperature (especially 250°C) Yield and Ultimate Tensile Strength. Dulin's alloy may have a copper content as low as 0.1%, which has no

significant effect on these properties. It is my opinion that nothing in Dulin would have motivated one of skill in the art to prepare an alloy of the instantly claimed ranges which has already been shown to demonstrate criticality and unexpected results across the entire claimed ranges.

13. I further declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the application or any patent issued thereon.

18 February 2009

Date



Michel Garat

	Cast reference								
Element	A	B	C	D	E	F	G	H	I
Si	8.011899	7.9582	7.8181	7.9812	8.048899	7.808899	7.9808	7.9369	7.9338
Fe	0.1041	0.114	0.1152	0.123	0.123	0.1127	0.1132	0.1176	0.1139
Cu	0.0034	0.0075	0.0029	0.0021	0.003	0.0024	0.0057	0.0042	0.0128
Mn	0.005	0.005	0.0033	0.0035	0.0035	0.0034	0.0036	0.0038	0.0035
Mg	0.4169	0.4246	0.3968	0.3911	0.4088	0.3812	0.4055	0.4028	0.3639
Ni	0.0036	0.0038	0.0036	0.0038	0.0037	0.0039	0.0036	0.0033	0.004
Zn	0.017	0.0173	0.007899	0.0083	0.0086	0.0088	0.0091	0.0092	0.0091
Ca	0.0007	0.00053	0.0005	0.00034	0.00054	0.00063	0.00073	0.00032	0.00062
Na	0.00046	0.000509	0.00023	0.0001	0.00035	0.0007	0.0005	0.00014	0.00021
P	0.00017	0.00012	0.00011	0.00013	0.00015	0.00011	0.0001	0.00013	0.00013
Pb	0.0012	0.0012	0.0011	0.0011	0.0012	0.0011	0.0011	0.0012	0.0011
Sb	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Sn	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Sr	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
Ti	0.149	0.145	0.1481	0.1331	0.1511	0.1567	0.1513	0.1401	0.1844
As	0.00057	0.00059	0.00057	0.00057	0.00057	0.00057	0.00057	0.00057	0.00057
B	0.00029	0.00005	0.00004	0.00003	0.00005	0.00005	0.00007	0.00007	0.00011
Be	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Bi	0.00007	0.00005	0.00011	0.00011	0.00006	0.00003	0.00008	0.00006	0.00004
Cd	0.00008	0.00014	0.00008	0.00009	0.00009	0.00007	0.00009	0.00007	0.00005
Cr	0.0009	0.0014	0.0018	0.0017	0.0012	0.0012	0.0011	0.001	0.0013
Ga	0.0081	0.0082	0.0111	0.012	0.0115	0.0114	0.0109	0.0118	0.0104
Hg	0.00083	0.00079	0.00086	0.00087	0.00087	0.00081	0.00083	0.00083	0.00078
Li	0.00001	0.00002	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.00001
V	0.0064	0.0066	0.0053	0.0062	0.0058	0.0058	0.0054	0.0062	0.0056
Zr	0.00064	0.00061	0.0008	0.00091	0.00087	0.00084	0.00083	0.00086	0.00082